You said, we did! Employer led work-simulated learning framework for enhancing ecology graduate employability

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Abstract

This study aimed to reduce the skills redundancy in ecology graduates by developing an employer tailored work-*simulated* learning curriculum. Furthermore, we evaluate the overall potential of work-simulated learning (WSL) as a key pedagogic component of a work-*integrated* learning (WIL) framework. We employed the DACUM (Developing a Curriculum) approach that encompassed i) surveying ecology-facing employers and job descriptions, ii) creating a programme of WSL, iii) a comprehensive review (student questionnaire and Industrial Steering Group workshop). A two-tiered curriculum was created; 15-credit FHEQ-5 residential field course and a 20-credit work-simulated learning FHEQ-6 module. Simulations included Phase I Habitat mapping, protected species surveys, and Preliminary Ecological Appraisals. Students developed greater knowledge of employment opportunities, enhanced technical skills, improved their CV and employability. The steering group substantiated and validated the WSL strategy, supporting the high relevance for enhancing graduate employability; while identifying curriculum gaps and areas for refinement. The outcomes highlight the wide-reaching benefits of practice-driven WSL opportunities as a key component of a wider WIL framework. HIE-employer interactions are also critical in ensuring content relevance, however we recommend the faculty exercise pragmatism in employing suitable pedagogic strategies to ensure they conform to the constraints of HEI while satisfying employer needs.

Key words

Work-integrated learning, STEM, graduate skills, conservation, fieldwork

Introduction

Over the past thirty years Higher Education Institutions (HEIs) have been charged with creating highly skilled graduates that enrich the labour work force (Bolden *et al*., 2009; Levy and Hopkins 2010; Rowe and Zegwaard 2017). In doing so a myriad of strategies have been introduced to develop the technical, transferable and interpersonal skills that promote the productive transition and effective integration of new graduates into the global economy. Yet many disciplines, particularly within STEM, are failing to meet employer demands (Winterbotham *et al.*, 2014; UKCES 2015). Over the recent decade the term Work-Integrated Learning (WIL) has been widely adopted as a broad umbrella term that represents any deliberate pedagogic activities that allows students to develop relevant work-place skills (Patrick *et al*., 2008; Ferns *et al.,* 2014; Sachs *et al*., 2017). Within the present study we investigate the effectiveness of one WIL approach; work-simulated learning, to develop employer-relevant skills and enhance graduate employability. Work-simulated learning specifically refers to components within a module or course that replicate work-place activities (Allan 2015; Sachs *et al*., 2017). We describe a four-year process that has encompassed rigorous engagement with employers to ensure the simulations develop relevant skills that enhance graduate employability in a competitive and saturated market. Furthermore, we scrutinised the effectiveness of the process by undertaking an in-depth review of the benefits of the simulations using student surveys and establishing an Industry Steering Group to review and provide guidance on the overall approach.

We complete the research by providing an in-depth evaluation of the approach employed within the present study, and the wider impacts of work-simulated learning in terms of the student experience, employability, faculty and institutional costs. The hope is to identify the role of work-simulated learning in undergraduate ecological programmes and provide guidance for how this can be effectively incorporated into WIL strategies. Presently, while it is highly likely that many undergraduate programmes incorporate work-simulated learning, there is limited evaluation of the effectiveness of the approach (specifically within STEM disciplines) and no comprehensive framework for adopting this within an overall WIL programme of study (at least within a UK context). This is further confounded by conflicting and varying definitions of work-integrated learning that has led to conceptual confusion in the literature (see Allan 2015 for a more comprehensive discussion). We have strived to address this current deficit in knowledge transfer and provide a comprehensive overview of work-simulated learning. The findings of this study have particular implications for the development of field-based environmental programmes within Biological/Environmental Sciences where the career goal of the undergraduate is to seek employment within the fields of conservation, environmental consultancies, Local and National Nature Authorities and environmentally focussed NGO's. Additionally, the employer-informed methodology represents a framework that can be fostered by all STEM disciplines to enhance employability within their undergraduates by promoting an effective programme that decreases the divergence in the skills gap (UKCES 2015; DoBIS 2016).

Background context: The skills gap

STEM skills are central to economic growth and play a critical role in developing the scientific knowledge that will procure future innovation and services (Atkinson & Mayo 2011; Wakeham 2016). However, policy makers, industrial and educational leaders have highlighted dissatisfaction with STEM graduates as they lack technical and transferable competencies (Bosworth *et al.*, 2013; Winterbotham *et al.,* 2014; UKCES 2015). Concerning shortfalls have been emphasised in Biological and Environmental Sciences (Wakeham 2016) where provisioning future generations of ecologists and conservation biologists with competence in applying modern environmental management methods at strategic and operational levels, is particularly important (Sundberg *et al.*, 2011; Steffen *et al.*, 2015; Warren 2015). The range of non-academic employment opportunities in ecology and conservation is significant (Muir & Schwartz 2009), however decreasing provisions (Smith 2004; Lock 2010) has contributed to this redundancy of employer-ready graduates (Hill *et al.,* 2003; ERFF 2010; IEEM, 2011; Lowden *et al.,* 2011; Sundberg *et al.,* 2011). Graduates themselves also sense they are inadequately prepared for employment in practical work, lacking specialist knowledge and advanced technical applications (Brown *et al.*, 2005; Scott 2005). Furthermore, there appears to be a cultural divide between research-led academic programmes, traditionally focusing on pure theoretical concepts, diverging significantly from the applied nature of the ecological sector jobs (Matter & Steidl 2000; Field *et al.*, 2014).

In order to achieve graduate-employer alignment it is essential that ecological curriculums are both employer-informed and practice-driven. By establishing the skills employers require, effective and well-balanced curriculums can be created (Junghagen, 2005; Watton and Truscott, 2006) as provisions can be refined to ensure they both satisfy the academic acquisition of theoretical knowledge while developing career-relevant professional skills (Rizvi & Aggarwal 2005; Hennemann & Liefner 2010) producing employable, highly skilled graduates. Despite employer engagement being common in more vocational professions such as health care and accountancy, there is limited evidence to suggest that this has been fully introduced into ecology and conservation programmes.

Work-Integrated Learning

In addition to ensuring curriculums are employer-aligned, providing students with the opportunity to practice and experience work-related technical skills is critical to enhancing graduate employability. While the specific definition remains contested (Allan 2015; Oliver 2015), Work-Integrated Learning (WIL) broadly represents purposeful pedagogic approaches that blend classroom experiences with practice in the workplace (Patrick *et al*., 2008; Ferns *et al.,* 2014; Sachs *et al*., 2017) to improve employment outcomes in the transition from university to work. Students benefit by gaining a better comprehension and acquisition of industry-required skills and an appreciation of the world of work (Jackson 2015). Employers also benefit as graduates with work experience align with the needs of stakeholders and promise a better return on investment as they provide skilled, adaptable, low-cost employees that can enhance long-term national productivity (Smith 2014). A range of WIL activities are now employed, each with variability in their application and utility; from modular to programme level, departmental to institutional, regional, national and internationally (Patrick *et al.*, 2008; Sacks *et al.*, 2016). For example, WIL can range from simulations embedded within a modular component (work-simulated learning) to industrial placement years at the programme level (workbased or workplace learning). In terms of international approaches, while the Australian Government has recently adopted a National Strategy on Work-Integrated Learning in HE, in the UK no such national strategy exists; institutions independently drive their employability agendas (Smith, 2012; Jackson 2015, OFFA/HEFCE, 2014; HDfE, 2017) and even definitions and conceptual models have yet to be definitively agreed (Allan 2015).

Each WIL strategy persists on a continuum of benefits and costs for students, HEIs and employers. These include variation in faculty verses employer control of content, delivery, logistics, administration, study duration, financial and resource costs (ACER, 2015). Each factor can unpredictably fluctuate and requires regular reviewing and strategic intervention. For example, in the UK there has been a rise in the number of programmes offering year-long industrial placements, however, recent cuts to maintenance loans has compromised their accessibility (Gov.uk, 2019). This is particularly problematic for disciplines within the ecology and conservation sector where most placements are in non-profit, volunteer-based organisations (Blickely *et al.*, 2012).

Developing alternative, inclusive and comparable opportunities to practice and develop work-relevant skills is essential. Work-simulated learning involves the creation of an environment to reflect functional workplace operations where students can experience a range of work-related scenarios and technical skills within a module or course of study (OfLT, 2014). Simulations may take place within the classroom or off campus and are used for a variety of purposes including introducing and development of professional skill, augmenting theory and practice and enhancing self-efficacy (Sachs *et al*., 2017). Integrating work experience through simulations offers a stepping-stone to full industrial work-based placements. Careful pedagogic planning, construction and application of simulations potentially allows students to practice professional technical skills under safe, inclusive environments with minimal administrative and resources costs to the institution and student (Sachs et al., 2017). Within ecological disciplines, simulating module-based, work-related activities potentially offers many benefits to enhancing student employability and reducing the skills gap and it is likely many programmes offer these opportunities, yet there is limited evidence and evaluation within the pedagogic literature that this WIL strategy has been applied to improve graduate outcomes.

Research aims and methodology

The aim of the present case study was to create an employer-informed work-simulated learning programme of study in an ecology and conservation focused degree programme that would allow students to develop and enhance professionally relevant technical skills. We employed a cognitive apprenticeship four dimensional model engaging employers with the curriculum design to ensure relevant content, sequencing and sociology, employing classical active learning methods to ensure the skills and knowledge were relevant and scaffolded to integrate theory and practice (Varghese *et al.*, 2012; Jackson 2015). To develop the work-simulated learning experience that incorporated relevant professional technical skills based on employer recommendations, a variation of the DACUM (Developing a Curriculum) process was employed. DACUM is a well-defined, collaborative three-phase process whereby an academic programme of study is designed based on workplace competencies (Hadfield *et al.*, 1997). Phase I of the DACUM involves engaging with employers to establish the most relevant skills required, here we employed a mixed-methods research approach encompassing questionnaires and analysis for job adverts. During Phase II the outcomes are used to create a new field ecology pathway. Phase III consists of reviewing the overall process, again we employed a mixed-methods research approach with a student questionnaire and establishment of an Industry Steering Group. The methods, results and outcomes from each of the three phases are described following a stepwise chronological framework. A comprehensive evaluation of the approaches adopted within this case study and the wider implications of work-simulated learning is provided in the discussion.

Case study

Faculty background and rationale

The study took place within the Biosciences degree programmes in Swansea University. A curriculum review of the ecological field course pathways was initiated in 2014. Historically Swansea Biosciences degrees (Biology, Zoology and Marine Biology) have a well-established background in providing quality ecological field courses due to the expertise and unique accessibility to the surrounding landscape encompassing both the Gower Area of Outstanding Natural Beauty and the Brecon Beacons Biosphere Reserve. Consequentially well subscribed field courses for both undergraduate and post graduate students are provisioned, which significantly contribute to high overall student satisfaction (95% student satisfaction, UniStats, ranked 28 Guardian League Tables for Biosciences 2018) and recruitment. Students undertaking our Biology and Zoology degrees typically follow an ecological/conservation pathway and their career aspirations reside within these sectors.

During the curriculum review we acknowledged that the traditionally passive style of learning and focus on natural history did not develop student employability and was not suited to increasing variation in learner diversity with a more diverse range of learner needs which compromised inclusivity (Collins *et al.*, 2012). We identified the need to create a new employer-focused curriculum that developed key technical skills to enhance student employability and aligned with employer requirements. Staff within the Biosciences department have fostered long-standing relationships within the local environmental sector, contributing to research, management and influencing environmental policy on a local and national scale. Therefore, engaging with local industrial partners was a natural progression to ensure the curriculum developed aligned with our student employment aspirations and reduced the skills gap. Approximately 90 students undertake the field course modules annually, however within Biosciences we have traditionally only been able to support between 10 to 20 students on year-long industrial work-based placement, therefore opportunities to provision work-related experiences are restricted, limited and highly competitive. To allow the breadth of students to experience and develop work-related skills, a work-simulated programme of professional ecological skills was deemed the most effective strategy.

Phase I: Employer questionnaire and job post analysis

During Phase I, a questionnaire was deployed to 60 local employers within the environmental sector of south Wales, encompassing a range of Non-Government Organisations (NGO), Environmental Consultancies, Local Councils and Statutory Nature Conservation Organisations (SNCO) to establish which skills were most valued. These were distributed across a range of positions (for example, senior managers and recruiters). The aim was to sample as many of the typical sectors that graduates with specialisms in environmental/ecological studies typically seek employment within (outlined by BES/IEEM, 2007). In addition to a set of demographic questions, the main four items each consisted of a question relating to the skills valued most in graduates and employers were required to rank the answers with the most important assigned the highest value and the least the lowest. The questions were not designed to lead the employer into choosing a perceived 'right' answer as no indication of the relevance of each answer was given, and negatively worded, reverse-scored items were avoided (Hinkin, 1998).

The first two questions were developed to specifically determine how employers viewed transferable skills, which ranged from broad to subject specific. The first question focussed on broad professional skills, such as report writing and numeracy. Question 2 addressed ICT competencies and the level of general and technical applications expected (for example, the use of Microsoft Excel, Word, statistical packages and Geographic Information Systems). Questions 3 and 4 focussed on technical skills and knowledge with question 3 assessing the topical knowledge (general ecology, ecological census techniques or environmental policy and legislation), while question 4 aimed to assess the relevant technical skills that should be introduced to students. This approach was employed to gauge the level of specific competencies employers expect within a graduate and allowed curriculum alignment and refinement. Each of the four questions was analysed separately using a non-parametric Kruskal-Wallis test to determine whether there were significant differences in the distribution of rankings between skills.

In addition to the questionnaire, and to provide a deeper insight into the skills and knowledge employers seek, the essential and desirable skills were reviewed from 60 graduate environmental job posted between February and May 2015. Posts were sourced primarily from environmentjobs.com (n = 49), indeed.co.uk (n = 2), and *ad hoc* SNCO sites (n = 9). Only jobs within the ecology, conservation and wildlife sectors were reviewed as these represented the career aspirations of our students. We aimed to select graduate jobs that were generally specified by requiring a degree only, but also included those which specified two years of experience or a post-graduate qualification as a desirable skill as some ecology students have significant volunteering experience. Additional data retrieved from each job posted included the job title, company, location (national, international), sector (private, government, non-profit), starting salary and whether full time and permanent or fixed term.

The sample included five international jobs and 55 jobs within the UK. We pooled international and UK adverts for all analyses. The search included a wide variety of jobs in each sector. Titles included field ecologist (private), environmental project officer (government) and People and Wildlife Assistant (non-profit). We analysed each job advert for technical skills, technical knowledge, and transferable skills. Each advertisement was reviewed by three reviewers that were trained on the standardised reviewing practice (e.g. applying the protocol for assessing different verbiage). We differentiated skills and knowledge based on the leading terminology, for example often 'have knowledge of conservation project management' was identified as technical knowledge, whereas if 'have experience of conservation project management' was used, we classified this as a technical skill. We deemed ecological report writing as a technical skill as a specific format is required that differs from general report writing skills. We did not include interpersonal skills (for example, organisation, negotiation, etc.) within this analysis as we were particularly interested in specific skills and knowledge and not interpersonal skills development. A list was derived from each advert and allocated into technical skills, transferable skills and technical knowledge which was agreed on following a preliminary review of the job posts. We calculated the number of times each skill/knowledge was requested across the job posts to determine the most sought after by employers. The percentage of adverts each skills/knowledge appeared in was also determined. The results of both the questionnaire and analysis of job posts was used to generate the new ecology curriculum (see Phase II).

Phase I: Employer questionnaire responses

A total of 24 out of 60 (40%) questionnaires were returned from 18 different local environment sector organisations (Table 1), with each equally well represented. From question 1, we found there was a significant difference in the median rank assigned to general versus more technical skills, with employers favouring the general transferable key skills of basic report writing, numeracy and oral communication (each scoring 84 in total ranking) over more technical skills such as experimental design (score of 35) and taxonomy (73) ($H = 32.804$, df = 4, $P < 0.001$, Figure 1a). Likewise, when focusing on ICT skills in question 2, greater importance was placed on the ability of graduates to be able to utilise general ICT programmes (such as information search engines, score of 84) as opposed to having knowledge and awareness of the technical, environmental specific programmes such as statistical analysis (score of 36) ($H = 44.597$, df = 3, $P < 0.001$, Figure 1b). This trend is comparable to that identified in the job posts section below.

In question three, when assessing if employers prefer knowledge and understanding of specialist subject topics (policy and legislation and field census techniques) or more general pure theoretical topics (ecology), significant differences were found between skills ($H = 26.748$, df = 2, $P < 0.001$, Figure 1c). Preference was shown for knowledge of general ecology, with total scores for ecology, field census techniques and policy and legislation being 64, 45, 35 respectively. Lastly, from question four, we found that the most highly ranked technical skill sought after by environmental sector employers was almost unanimously knowledge of habitat surveys (score of 157). Taxonomic knowledge and surveying skills for protected or indicator taxa such as freshwater invertebrates (score 98), birds (score 101), mammals (score 98) and terrestrial invertebrates (score 101) were approximately equally valued, indicating the variety in preference between those completing the questionnaire. Herpetological knowledge and laboratory skills were ranked the least important skills (score of 72 and 45 respectively) (H = 72.122, df = 2, $P < 0.001$, Figure 1d).

Job post analysis

Of the 60 posts reviewed 24 were full-time permanent (40%), 34 were full-time fixed-term (56%), one part-time permanent (2%) and one part-time fixed term (2%) which highlights the competitive nature of attaining fixed employment as a graduate in the ecological/conservation sector. The highest average earnings were for full-time permanent posts (Table 2) with an average wage of £27,631 compared to full-time fixed-term posts £23,776. Generally, these higher paid posts specified further study or professional experience. In total 80 technical and 46 transferable skills were identified and technical knowledge of 45 topics was identified, those with more than one citation are listed in Table 3. A comprehensive list is included in the Supplementary Information.

The results of the questionnaire and job posts were used during Phase II to design the work-simulated learning curriculum for the Biology and Zoology degree programmes. Specifically, the job posts were used to determine the most appropriate simulated activities, whereas the employer questionnaire was used to inform how much time should be dedicated to experiencing and refining each technical and transferable skill.

Phase II: Curriculum development and work-simulated learning

Content development: Establishing the foundations

Analysis of the findings from both the questionnaire and job posts indicated that broad knowledge of ecological concepts (species identification, natural history, survey techniques) are essential in graduates wishing to pursue a career in ecology and conservation. Before we could introduce work-simulated learning we identified the need to establish core knowledge of general ecology and conservation and it would not be possible to fit all the required professional elements into a single 20 credit module without providing the foundations of theory and practice. We therefore created a 15-credit residential field course in FHEQ Level 5 introducing general ecology, species identification, sampling techniques and natural history (Table 4). The aim was to then build on this with more relevant work-simulated professional skills that would bridge the gap between employer requirements in FHEQ Level 6 (Figure 2). We focused on the three dominant UK habitats (grasslands, freshwater and woodland) and introduced a broad range of ecological survey techniques. As the field course was residential it provided ample opportunity to teach and observe the general technical skills and knowledge identified (Maw *et al.*, 2011). The assessments created enhanced the key transferable skills highlighted by employers; communication was enhanced as students were required to work in groups (Burke, 2011) and partake in informal presentations. A strong emphasis was placed on data handling, analysing and displaying and report writing.

Work-simulated learning

The work-simulated learning consisted of a 20 credit FHEQ Level 6 module titled *Professional skills in conservation ecology*. The module entailed five days of field-based simulation, each themed around a key technical skill (Table 3). The simulated activities were selected based on an evaluation of the job descriptions, informal *ad hoc* interviews with employers and professional academic judgement of logistic pedagogic approaches that would be achievable with a class size of 70+ and within 20 FHEQ credits (recommended 40 hours of contact time and 160 hours of independent study). The analysis of the job posts revealed skills that are considered core in subject level benchmarks such as statistical analysis and experimental design (Reeve & Gallacher 2005; QAA 2016) were not highly sought after by employers within the ecological/conservation sector and were discounted from the module design.

We aimed to incorporate as many of the top technical skills and knowledge throughout the module with the highest-ranking skills and knowledge reinforced through every simulation (see Table 3). The course begun with an introduction to policy, legislation and protected species and the first activity was designed to refresh students' field surveying and identification, building on the FHEQ Level 5 field course. Before each field activity a lecture was provided outlining the habitat descriptions, conservation issues, legislation, theory behind the surveying methods, practical applications, and management implications. Field-based simulations were deemed to be the most effective approach (as opposed to classroom or workshop activities) as the applied nature of the simulations align with more active, experiential learning and real world contexts.

It was not possible to cover all eleven UK habitats in sufficient depth within a 20 credit module so we chose to build upon the FHEQ Level 5 field courses and focus on woodlands, grasslands and freshwater (although all habitats were discussed). Each activity focused on habitats (as specified in the questionnaire) and was based around a survey technique that would be undertaken as a professional ecologist/conservation biologist, with the theory, common, dominant, rare and protected species discussed. Phase I and Phase II habitat surveys were specified in the job post essential and desirable criteria, but also within the job descriptions, which was not encapsulated in the analysis. Both techniques are highlighted by the IEEM (now CIEEM) as skills graduates should be familiar with (IEEM, 2007). Guidance from informal interviews with professional consultants also identified these techniques as being the most important consultancy skills. Each technique allows students to refine identification skills and appreciate the value of different habitats for protected species. River Habitat Surveys and macroinvertebrate biological indicator surveys formed the second simulated activities and were included as these are key techniques employed within government agencies such as the

Environment Agency. Ten of the sixty posts were focused around management of freshwater resources, therefore understanding these systems was deemed important enough to allocate a portion of the module. The CIEEM has also identified a gap within freshwater biology expertise (IEEM 2011). The third simulation encompassed Common Standards Monitoring (CSM). CSM is employed regularly to assess and monitor European protected habitats (for example, Special Areas of Conservation) and species (McLeod 2005). Informal interviews with SNCOs also indicated this would be an essential technique for graduates and enhance their knowledge of conservation issues and monitoring strategies. Of the protected species surveys we were limited in what we could achieve in detail and therefore, based on job descriptions, the posts advertised and informal discussions with ecological consultants, bat surveys were considered the most important skills to develop. We therefore built on the FHEQ Level 5 formative activity and included a professional bat survey. Other protected species surveys were described and knowledge of them was summatively assessed.

The final simulation required students to undertake a Preliminary Ecological Appraisal (PEA). A simulation was based around a scenario whereby a visitor centre was proposed to be built in a Special Area of Conservation and the students were professional consultants instructed to undertake the PEA. PEAs have a range of purposes; one key use is in the site development process to gather data on existing environmental conditions, often with the intention of conducting a preliminary assessment of likely impacts of development schemes or establishing the baseline for future monitoring. This simulation allowed students to put into practice all the skills they had developed as it required them to identify the main habitats and key indicator, rare or protected species, potential threats, mitigation, legislation and management actions. In doing so students were required to demonstrate knowledge of nine of the top ten technical skills and knowledge identified in the job posts (including GIS, project design and management, see Supplementary Information for an in-depth description of the curriculum and assessment).

Many of the transferable skills identified in the top 20 were considered highly specific (for example, budgeting, community and volunteer engagement). Due to time constraints and a limit to what can be achieved in a 20 credit module (in alignment with subject level benchmarks) we made the executive evaluation to exclude these and instead focus on achievable core transferable skills (ICT, communication). Each of these transferable skills was practiced within the assessment which required technical reports and handling of ecological data. Both the CMS and PEA simulations involved elements of stakeholder engagement.

Authentic assessments were designed to align with the work-related activities. For example, knowledge of habitats and key species were assessed via an indicator species test. Deeper learning was assessed in the ecological reports which required a professional level of synthesis and analysis of ecological information and data analysis and was followed by critical evaluation of the habitats and application of the knowledge to provide guidance for habitat management. A complete PEA report formed 50% of the final assessment. This required students to demonstrate essential technical knowledge of habitat management, conservation issues, legislation and policy and protected species surveys while enhancing the technical skills of data handling and ecological report writing.

Phase III: Work-simulated learning review

Phase III employed a further mixed-methods research approach to assess the students experience and employer opinions of the ecology pathway developed. A quantitative questionnaire was employed to collect data on the students' experience having completed both modules and was disseminated to students (n = 80) in 2018. The overall aim was to determine if the students thought the experience had improved their employability, for example, by enhancing their CV, generating greater awareness of work opportunities or enhancing technical and transferable skills. Six statements were scored on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) see Figure 3.

In order to qualitatively review the pathway, we created a steering group which consisted of 11 industrial representatives from our local environmental sector and the four leading faculty members and invited them to attend a workshop to validate the modules created. The workshop was held on 14th December 2018. The steering group consisted of representatives from the local SNCO (n = 3), Natural Resources Wales (NRW, n = 3), CIEEM (n = 1), National Trust (n = 1) and ecological consultants (n = 3). Course information (handbooks, lecture material, assessment details and examples of students work) was supplied four weeks in advance of the workshop. The workshop was structured into three sections: 1). Review of the two-tiered structure and foundation of skills and knowledge developed in FHEQ Level 5, 2). Assessment of the FHEQ Level 6 work-simulated strategies 3). Strategic planning and recommendations for bridging future skills development and forging HEI-employer relations. Minutes were recorded of the workshop and qualitatively analysed and summarised to provide an overview of employer review.

Student questionnaire responses

A total of 36 (45%) students completed the questionnaire. The results showed that students either agreed or strongly agreed the work-simulated activities enhanced their CV, developed their employability skills and introduced them to key practical elements within the ecological sector (89%, 100% and 89% respectively). In addition, the field courses improved students' overall engagement with their degree and 100% either agreed or strongly agreed they enjoyed the courses.

Employer review outcomes

The minutes recorded during the workshop are summarised in Table 5. A questionnaire was sent out *ad hoc* following the workshop which consisted of open questions that emulated the structure of the workshop with the aim of sweeping up any aspects or concerns not discussed within the workshop. However, only four questionnaires were returned, and a review of the responses showed they reflected the outcomes of the workshop, therefore, the results have been combined in Table 5. The summary aims to highlight the positives and weaknesses identified by employers and the faculty responses. For ease of communication, where employers have agreed, the comments have been re-adapted and combined with the initials of the organisation stated in parenthesis after the comment. The results are further evaluated in the discussion section below.

Discussion and evaluation

Utilising work-simulated learning in ecology curriculums reduces the gap in specialist and transferable skills and subject-specific knowledge (on a local scale at least). Furthermore, engaging employers in the curriculum design enhances learners' awareness of the practical skills required within employment and the work opportunities within the relevant field, potentially improving employability (Brown, *et al.,* 2005; Saunders and Zuzel, 2010). By utilising this holistic, three-stage cycle, we were able to constructively align and fine-tune course material and apportion the appropriate amount of effort and resources into delivering relevant, professional competencies to graduates while honing transferable skills. Each phase of operation contributed critical information to ensure the technical skills and knowledge represented employer requirements, however the approaches fostered often presented challenges and required compromise. The discussion below evaluates the utility and outcomes of each stage and provides recommendations for adopting the present strategy for engaging employers in the design of work-simulated learning and the wider curriculum.

Phase I and Phase II evaluation

Utilising a mixed-methods research strategy (questionnaire and job posts analysis) to gather data on employer requirements fundamentally altered our approach to developing the work-simulated learning and ensured the knowledge-base and skills matched employer needs. One of the most significant changes in the curriculum design was the two-tiered approach of introducing the broad skills and knowledge in ecology in the FHEQ Level 5 module, which allowed more specific technical skills development in work-simulated learning in FHEQ Level 6. Establishing a foundation fundamentally enhanced what was achievable within the simulations, promoting deeper learning and understanding as students could contextualise more easily and refer to prior skills development (Simons and Klein, 2007). The Steering Group was unanimous in approving the two-tiered curriculum design and confirmed the knowledge and techniques were relevant and of sufficient depth. Based on our experience we would strongly recommend that simulations are aligned with prior knowledge in order to maximise effective learning, particularly if there is limited opportunity to develop employer-focused skills such as in the present case study.

In addition to refining overall curriculum structure, the relevance of the content was also significantly enhanced. For example, of the technical skills employers seek, broad knowledge and understanding of habitats and survey methods was strongly identified, this was given the greatest provision within the simulations (i.e. Phase 1 habitat surveys, CSM and PEAs). This also aligns with recommendations and guidance from professional ecological and conservation societies (IEEM 2007, 2011) and was also approved by the Steering Group as being the most relevant skills delivered in the course. The Steering Group also confirmed that these skills would make a graduate stand out based on this experience.

Protected species surveys are key ecological skills, yet there was no one taxa/census that particularly stood out as essential (Table 3). However, the Steering Group and job descriptions recommend graduates choose a specific specialism in one taxon (for example, bird, mammal or invertebrate) and independently develop skills in identifying and surveying that particular group. We aimed therefore to introduce students to the ecology of the main protected species and experience the technical surveying and conservation skills in the work-simulations with a view that they would autonomously specialise in an area by gaining experience, through voluntary work experience for example. Indeed, graduates competing in the conservation job market benefit by independently gaining skills and should not necessarily expect to be competent in these skills simply by completing their chosen degree path (Pérez, 2005; Blickley et al. 2012). This information prevented curriculum drift and allowed us to apportion the relevant amount of time and effort into each key aspect. The Steering group also identified and appreciate some of the limitations HEIs face in developing the depth of knowledge required for some specialised industrial roles (within the ecological sector at least).

The job applications and employer questionnaires responses placed a premium on transferable skills (communication, ICT, numeracy), we therefore ensured these generic skills were integrated within the curriculum (BES/IEEM 2011). However, conflict can arise when employment driven agendas focusing on transferable skills replace the pure, in-depth pedagogical processes associated with the theoretical study of a discipline resulting in a loss of opportunity to deliver specialist knowledge (York, 2006; Hennemann & Liefner, 2010). For example, we refrained from teaching more academically focused skills such as statistical analysis in favour of developing more general skills of data handling, presentation, report writing and communication. Examples of best practice indicate that when teaching transferable skills, they should be non-mutually exclusive and taught concurrently with hard knowledge-based topics (Scott, 2005). Within the present study, work-simulated activities provided a framework that allowed the formation of a curriculum that complemented educational theory with professional practice and simultaneously incorporated key transferable employability skills. Indeed, student responses indicated the skills taught introduced them to key practical aspects, while enhancing their knowledge of where to seek employment and improved both their CV and general transferable employability skills (Figure 2, Watton and Truscott, 2006) further substantiating the benefits of work-simulated learning.

Both questionnaires and analysis of job posts have been used successfully to influence curriculum designs previously (Blickly *et al.*, 2012; Whelan 2017). However, the qualitative nature of the approach requires interpretation and prioritisation by the faculty to develop a pedagogic strategy that meets the constraints of HE. Within our case study, the mixed-model strategy helped to both identify and prioritise the taught content. For example, while the questionnaire had some utility in determining the baseline requirements and value employers placed on technical and transferable skills, the closed nature of the questions made interpretation and development of specific work-simulations challenging. If a questionnaire was to be the sole method used to engage employers in curriculum design, we would recommend a more in-depth survey, with a greater range of open questions, than the one employed here. Within the present study, analysis of the jobs post alleviated these issues and provided a more in-depth overview of employer requirements and allowed us to create effective, relevant simulations. However, the analysis was time consuming and required significant commitment form the faculty. In order to employ this approach in future curriculum development we would recommend faculty strive to achieve and secure appropriate representation within workload models as this resource partitioning is often overlooked and underrepresented (Rowe and Zegwaard, 2017).

The costs of developing and introducing the new curriculum were minimal compared to the benefits gained for the student experience. Work-simulated learning provided a low-cost (no additional resources were required), inclusive means of enhancing employability skills in all our students. Additional indirect benefits were also identified by enhancing recruitment and promoting greater engagement with the learning process (Figure 3). Securing relations with industrial partners and created indirect benefits (discussed below). Based on these benefits we would strongly recommend engaging employers and implementing work-simulated learning as essential components of any ecological-facing degree programme as a means to reduce the gap in graduate skills with employer requirements.

Industrial Steering group evaluations

While in many vocational disciplines employers regularly have input, and can lead curriculum development, we could find no evidence within the pedagogic literature of the same approach being adopted within the ecological sector. Bolden *et al*. (2009) identified a number of facilitators and barriers to effective HE-employer engagement including: strategic fit for the HEI and its partners; finding partners and establishing the relationship; designing and delivering an appropriate learning package; developing, sustaining and leading the partnership; staff resourcing and capability; culture and systems supportive of collaboration; funding and investment. Within the present study, creating a Steering Group to review the curriculum and work-simulated learning has been fundamental in validation, refinement and enhancement. However, from a faculty perspective, employers were essential in highlighting gaps and suggesting opportunities for graduates to enhance their employment, but it was also identified that employers often do not recognise, and can be out of touch with the constraints and pressure HEIs currently face. For example, gaps were highlighted by the Steering Group, such as the omission of the most recent legislation. This reinforces the benefit of engaging employers to ensure the curriculum is accurate and up-to-date as advice is provided from those at the coal-face, whereas non-practicing academics can lose the overview. It was also identified that some technological advances were not practiced within the courses. We acknowledged however that these were delivered in other modules across the programmes and inclusion of these techniques would be at the cost of other activities deemed higher priority, we therefore developed a strategy to signpost these techniques within the work simulated learning activities (Table 5).

Some of the technical skills developed during the work-simulated learning were queried and deemed only loosely relevant by the Steering Group, specifically, the River Habitat Surveys (see Supplementary Information for the full curriculum). This conflicts with research suggesting there is a knowledge gap in freshwater biology and a current lack of expertise within this specific field (CIEEM, 2011). River Habitat Surveys have been fundamental in developing key environmental policy and legislation therefore learning this survey protocol provides a unique pedagogic opportunity for students to employ a range of skills and knowledge they have developed and apply it in a new situation while also developing a range of interpersonal skills. These factors were deemed highly valuable by the faculty and we therefore chose to keep this work-simulation activity centrally within the schedule as it also provides us with the opportunity to formatively assess the students' knowledge and understanding. Furthermore, it was highlighted by the Steering Group that the habitats visited were not representative of 'real world' work, for example, utilising the Gower Area of Outstanding Natural Beauty for our habitats, whereas most conservation work entails engagement with degraded and often polluted habitats. This presented a conundrum as within HE we are presently challenged with not only providing a high-quality education, but also ensuring high student satisfaction and a quality learning experience. These factors have significant impact at an institutional level as they dictate league table positions, retention and recruitment. These examples of HEI-employer conflict suggest that in order to enhance graduate prospects not only do HEIs need to be aware of employer requirements, but also employers need to be more aware of the constraints and pressures of HEIs. Reeve and Gallacher (2005) have also identified conflicts such as the emergence of the quality assurance agenda within higher education, which is reducing the influence of employers. While the Steering Group have been critical in evaluation the curriculum, as with the analysis and job posts and questionnaire we would recommend faculties continue to exercise academic judgement to ensure a compromise between employers, HEI requirements and student learning gains.

Work-simulated learning and the wider WIL framework

Employer and HEI relationships are often two-way and multifaceted with employers offering the opportunity to develop graduates via placements and work experience, and HEIs offering opportunities for upskilling the workforce (Bolden *et al.,* 2009). Work-based learning strategies such as Industrial Placement Years can pose significant financial costs to both students (depending on funding), institutions (administration) and employers (time and resource investment). The simulated learning we provided only incurred financial costs that are comparable to that of any other local field-based modules in terms of equipment, development and delivery. No additional costs were required from the students and the contribution from employers was part of their strategic missions to engage with education. Therefore simulated workplace activities have the added benefit of reducing overall student and administrative costs. We also observed additional indirect benefits by securing long-standing relationships with our industrial partners which have led to applied, impactful research opportunities and grant related income (pers. obs.). The professional skills module has also been used to enhance recruitment and play a significant role in our advertising strategy (pers. obs.) and degree accreditation which has also provided an indirect financial benefit.

A limitation with work-simulated learning when compared to other work-based strategies such as Industrial Placement Years is the short duration and modular nature which could lead to compartmentalization and detachment from other more academically focused modules and actual work-place activities. There is a general recognition that industrial placements improve the employment outcomes for graduates as they are immersed within actual work-place learning and not only develop key technical skills and knowledge, but also enhanced transferable and interpersonal skills such as organisation, negotiation and time-management (Crawford and Wang 2016). However the evidence for the benefits of Industrial Years is mixed and there is little empirical evidence of graduate skills transferring to the work place (Blume *et al.,* 2010). Also positive impacts on academic performance, maturity and motivation may be confounded by the likelihood for more proficient students generally securing a placement (Bullock *et al.,* 2009). Industrial placements can exclude minority groups, mature and disabled students and in some cases disparity has been reported between industrial partners in students skills training, mentoring and assessment (Jachson 2015). The work-simulated learning we provided allowed all students equal opportunity to develop and practice work-related skills and therefore is a more inclusive approach that alleviates some of the issues associated with industrial placements. Additionally, we could offer this experience to the entire cohort but we have limited industrial placements available and resources for both administrative and academic support. We also had greater control of the quality of the experience as our knowledge of prior learning and our students learning needs allowed us to appropriately pitch achievable, realistic learning outcomes empowering students to feel more confident their employability skills.

Further studies would need to be conducted to determine if work-simulated learning actually translates into improving employability. Quantifying employment benefits from pedagogic initiatives is notoriously difficult due to the array of confounding factors ranging from individual differences in student aptitude, to the economic climate dictating employment opportunities (O'Leary 2016). There is a possibility that the technical skills do not transfer to actual employment, as well as students having variable employment aspirations, therefore we recommend that work-simulations should not be the sole opportunity for students to practice and develop professional technical and transferable skills. Instead, work-simulated learning should form the basis of a programme level framework which allows students to choose to develop the skills further by undertaking more in-depth work-based placements.

There is currently no definitive national strategy to promote a WIL framework within HE institutions in the UK. Based on the findings of the present case study we would recommend a unified approach to ensuring all relevant programmes offer a full complement of WIL opportunities from simulations to more in-depth workbased placements. To develop an effective national programme best practice should be taken from countries that have already incorporated a WIL action plan within their HEIs. Given the demand on HEIs to create employable graduates, a shift may be required in the description of subject level benchmarks to incorporate the development of not only transferable skills, but also specific employment-based technical skills and knowledge. Funding and appropriate workload allocations should be made available to allow academics to develop the necessary relationships with local industrial partners and allocate time to developing the relevant activities (Rowe and Zegwaard, 2017).

To conclude, developing innovative, employer-informed curriculums that enhance student employability and reduce the skills gap in STEM disciplines (Sundberg *et al.*, 2011; Warren, 2015), is particularly relevant within the current HE climate (Levy & Hopkins 2010; Störmer *et al.*, 2014). Increasing demand to provide greater value for money (CMA, 2015; Neves & Hillman 2016), premium learning experiences and enhanced employability prospects (HEA/HEPI, 2016) has resulted in a necessity for HEIs to engage more thoroughly with developments within research and industry to ensure curriculums are relevant and up-to-date (Karagiannis, 2009; HEA/HEPI, 2016; Neves & Hillman 2016). In order to produce graduates that possess a competitive skill set, a refined, fine-tuned, employer-informed curriculum should be offered to account for the challenges currently observed within crammed curriculums compounded by large cohort sizes (Mason *et al.*, 2009). The holistic, three-stage approach to developing work-simulated learning employed within the present study exemplifies a low-cost, high-reward opportunity to enhance the quality of learning opportunities, industry-institute relations, student recruitment, satisfaction and employability. In a broader context, the skills and knowledge attained during field-based courses will critically enhance the tool kit required for the next generation of environmental scientists to tackle global species extinctions, loss of ecosystem functioning and degradation of natural resources (Freeman et al., 2001; Steffen et al., 2015). While the present study focuses on the ecological sector, the strategies adopted can be fostered as an intermediate work-place experience by any discipline. In particular, theoretical disciplines that do not traditionally integrate with industry could employ this approach to give students a taster of work-place learning. More generally, work-simulated learning should form a key component of a work-integrated learning framework applied on a national level.

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Table 1. Demographics of participating environmental sector employer's questionnaire responses.

Sector	Number of institutions	Number of responses
Nature Trust	7	7
Consultancy	3	5
Council	2	5
Government Organisation	3	4
Miscellaneous	3	3
Total	18	24

Table 2. Profile of earning potential (GBP) for ecology graduates based on 60 posts (2014/15).

Pay (GBP)	Mean	Mode	Range	Median	Min	Max
Overall	22,140	32,411	25,500	23,500	16,000	41,500
Fixed term	23,776	32,411	21,500	22,010	16,000	37,500
Permanent	27,631	20,000	21,610	27,225	19,890	41,500

Table 3. Summary and frequency of technical (*n* = 39), and transferable skills (*n* = 23) and technical knowledge (*n* = 19) cited more than once in 60 job posts analysed between 2014/2015. The transferable and technical skills and knowledge highlighted were integrated into the work-simulated learning curriculum design.

Technical skills	Freq.	Technical knowledge	Freq.	Transferable skills	Freq.
Data (handling, analysis, interp.)	**30**	**Policy and legislation**	**27**	**Communication**	**60**
Field surveys	**27**	**Conservation issues**	**24**	Driving licence	30
GIS	**27**	**Habitats**	**13**	**IT (Excel, Word)**	**23**
Project design, mgmt., delivery	**26**	**Protected species**	**13**	**Stakeholder engagement**	**16**
Ecological reports	**23**	**Habitat (management, creation, restoration)**	**12**	Budgeting	15
CIEEM membership	15	**Project design, mgmt., delivery**	**9**	Community engagement	10
Identification	**13**	**Natural history**	**8**	Volunteer engagement	7
Protected species licence	**12**	**Health and safety**	**4**	First aid	6
Protected species surveys	**10**	**Invasive species**	**3**	Social media	5
Risk assessment	**10**	**Protected habitats**	**3**	Working inclusively	5
Habitat management/conservation	**8**	Countryside management	2	Event management	4
Communication	**7**	Ecosystem services	2	Lead volunteers	4
Ecological monitoring	**7**	**Environmental risk**	**2**	Managing volunteers	4
Certificate competencies	6	**Field surveys (habitat)**	**2**	Planning	3
Environmental impact assessment	6	**Landscape management**	**2**	Customer service	2
CSCS card	4	**Local habitat knowledge**	**2**	D1 licence	2
Ecological mitigation	4	**Planning and mitigation policy**	**2**	**Numeracy**	**2**
Habitat creation/restoration	4	**Species management**	**2**	**Oral presentations**	**2**
Website (development, mgmt.)	4	**Wildlife**	**2**	Organising volunteers	2
Phase 1 habitat surveys	3			Own vehicle	2
ESPL applications	3			Partnership working	2
Habitat regulations assessment	3			Public speaking	2
Countryside management	3			Raising awareness	2
Programming (Python)	3				
R studio	3				
Research	3				
Arboriculture	2				
Biological recording	**2**				
Ecological clerk of work	2				
Experimental design	2				
Funding applications	2				
Invasive species management	2				
Landscape management	2				
Navigation	2				
Outdoor pursuits	2				
Recorder 6	2				
Scientific reports	2				
SQL databases	2				

Table 4. List of the knowledge and skills developed during the 15 credit FHEQ Level 5 and 20 credit professional skills FHEQ Level 6 modules

	FHEQ Level 5: Introduction to field ecology	FHEQ Level 6: Professional skills in conservation
Technical knowledge	General pure ecology, habitat and species identification, taxonomy, natural history	General ecology, indicator species identification, community analysis, environmental policy and legislation, protected habitat and species surveying, habitat management and conservation species recording
Technical skills	Ecological surveying techniques: quadrat and transect sampling, sweep and dip netting, moth and bat recording, abiotic sampling, map reading/navigation, dichotomous keys and guides	Phase 1 habitat survey, GIS and habitat mapping, Common Standard Monitoring, Phase II habitat surveys, Protected species surveys, River Habitat Surveys, biological quality indicator surveys, dichotomous keys, Preliminary Ecological Appraisals
Transferable skills	Ecological report writing, data handling, analysis and presentation, oral presentations, problem solving, group work, ICT, time management, organisation	Professional ecological report writing, data handling, analysis and presentation, oral presentations, problem solving, group work, ICT, time management, organisation, cover letter writing, self-evaluation, risk assessment, critical thinking and evaluation

Table 5. Summary notes taken during the workshop validating the programmes held on 14th December 218. Positives and challenges are identified and the response given by the faculty. Initials in parenthesis represent the organisation and the number identifies a different individual within that organisation (NRW – Natural Resources Wales, SNCO – Statutory Nature Conservation Organisation, Consult – Ecological Consultant).

Year 2 15-credits residential module	
Steering group positives	
Technical skills and knowledge developed by this course are very relevant to local government countryside management sector (SNCO 2, SNCO 3, NRW 1), conservation related work (NRW 1)	
Course is pitched at the correct level, sufficient foundation for beginning a career in a local authority (SNCO 2, NRW 2)	
Good survey skills and techniques underpin everything (SNCO 2)	
Excellent course content been (SNCO 2, NRW 2), Beneficial concepts such as habitat succession covered (NRW 1)	
Familiarity with dichotomous keys will enhance employability. (NRW 1)	
Skills definitely transferable. (NRW 2)	
There is a huge knowledge gap with graduates having limited field and taxonomic skills, especially when it comes to plants and invertebrates. A graduate with these skills would be in great demand in the consultancy and conservation sector. (SNCO 3, Consult 3)	
Field courses being based around UK wildlife rather than overseas. (SNCO 3)	
Steering group challenges	***Faculty response***
Limited range of habitats covered. Need to find more species rich habitats (NRW 1), marshy grasslands, brownfields (NRW 1, SNCO 1, SNCO 2, Consult 3)	Restricted by group sizes, seasonality and logistic access to these habitats in a 15 credit module
Important to see how management has affected habitats e.g. industrial use/farmland – why are these habitats in this condition? (SNCO 1)	This is discussed in the lecture material for each habitat and as a broad overview of the course. Signpost more effectively to Steering Group
Important to teach more ecological succession – introduce in Y1 and 2, reinforce in Y3 (SNCO 2, NRW 1)	This is presently taught in Year 1 Ecology, but was not presented to the Steering Group
Increasingly important to be aware of new technologies, e.g. interpretation of habitats on remote images, phone apps, camera traps, open source image analysis software packages, DNA analysis etc. (NRW 1)	Students are introduced to a range of technologies in other modules. This can be signposted within the field course modules.
Could bottle trapping/torch searching/egg searching for amphibians be included? Tree bat surveys? (SNCO 3, Consult 3)	Advice accepted and efforts will be made to make enhancements
Work-simulated learning	
Steering group positives	
Linking species to legislation (Consult 2)	
Covering amazing breadth in these course (Consult 2)	

Biological indicators is fundamental (NRW 1, SNCO 2)	
Knowledge of protected species is highly advantageous. (SNCO 2)	
Content and technical skills are very relevant. (SNCO 2, SNCO 3, NRW 1, Consult 1, Consult 3)	
Course is pitched at a level appropriate for a Year 3 UG, should equip them with the skills needed to start a career in local government countryside management. (SNCO 2)	
Step up in content will give students the higher level of skill needed to move on to the more technical elements of local government natural resources work such as issuing planning guidance on mitigation for protected species. (SNCO 2)	
I would not wish to amend the excellent course content that you have put together. It will give graduates the skills we are looking for. (SNCO 2)	
Engaging with Phase I habitat recognition is particularly important, there is a case for increasing the exposure. (NRW 1, SNCO 3, Consult 2, Consult 3). Pleased to see phase 1, PEA and NVC included. Not many CVs from graduates can list all these, so this is good to see. (SNCO 3, Consult 3)	
Generally very impressed with this course. (NRW 2)	
Steering group challenges	***Faculty response***
Important to ensure you know why you are doing it (PEAs). Driven by planning policy and needs Welsh context. Double check surveys are in line with guidelines and that the level of survey effort is appropriate. Need to demonstrate why you have ruled out certain surveys. Justification for why you would choose they surveys you propose. (SNCO 1)	These aspects identified need addressing to enhance the course content and students broader understanding and will be added to the course in future
Some key legislation omitted (SNCO 1, Consult 1)	
Take students to visit developments and discuss how it was achieved i.e. sand dune restoration or wind farm on peat – interesting ecology and demonstration of developers considering ecological aspects (SNCO 1).	Restrictions due to logistics and time availability make this difficult. This would need to be included at the cost of other technical skills/knowledge deemed more appropriate by the faculty.
Introduce students to places that are less ‘attractive’ and probably more diverse. This is reality (NRW 1).	Constraints on ensuring a high quality student experience confound this
RHS not appropriate – should you take a step back and look broader e.g. geomorphology and fluvial networks. Need a mix of general and specialist skills. (NRW 3)	Fluvial geomorphology is discussed in-depth in both Y2 and Y3 courses. Further evidence suggests this technique is relevant and it has additional pedagogic benefits of allowing problem-solving and application of skills and knowledge
The most obvious gap is the need to incorporate the roles of new technologies as they become operational, e.g. satellite image habitat interpretation and change detection. (NRW 1)	Time limitations restrict this. Addition would be at the cost of other skills deemed more important by the faculty
Hedgerow surveys? EcIA? Mitigation/compensation/licensing? Dealing with developers? Bat data analysis? Legislation – EPS and other protected species (SNCO 3)	As above restrictions apply

Figure 1. Employer ranking of graduate competencies for (a) transferable skills, (b) ICT (c) knowledge (d) professional technical skills (N = 24), 1 = least valued.

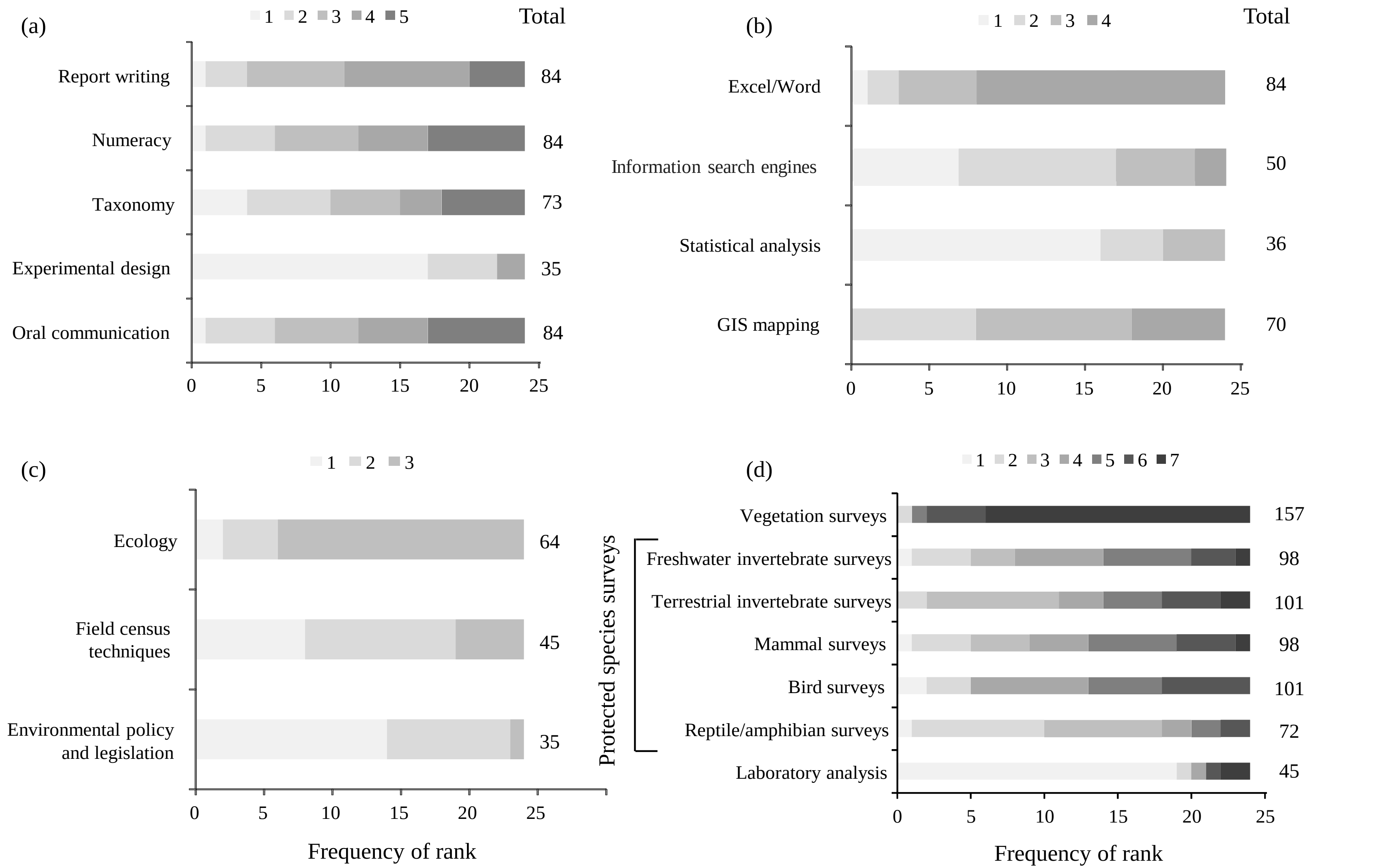

Figure 2. Skills network depicting the development of general technical and transferable skills and knowledge developed in the Introduction to field ecology (FHEQ Level 5) and the interconnected relationship in development within the work-simulated learning (FHEQ Level 6) Professional Skills in conservation

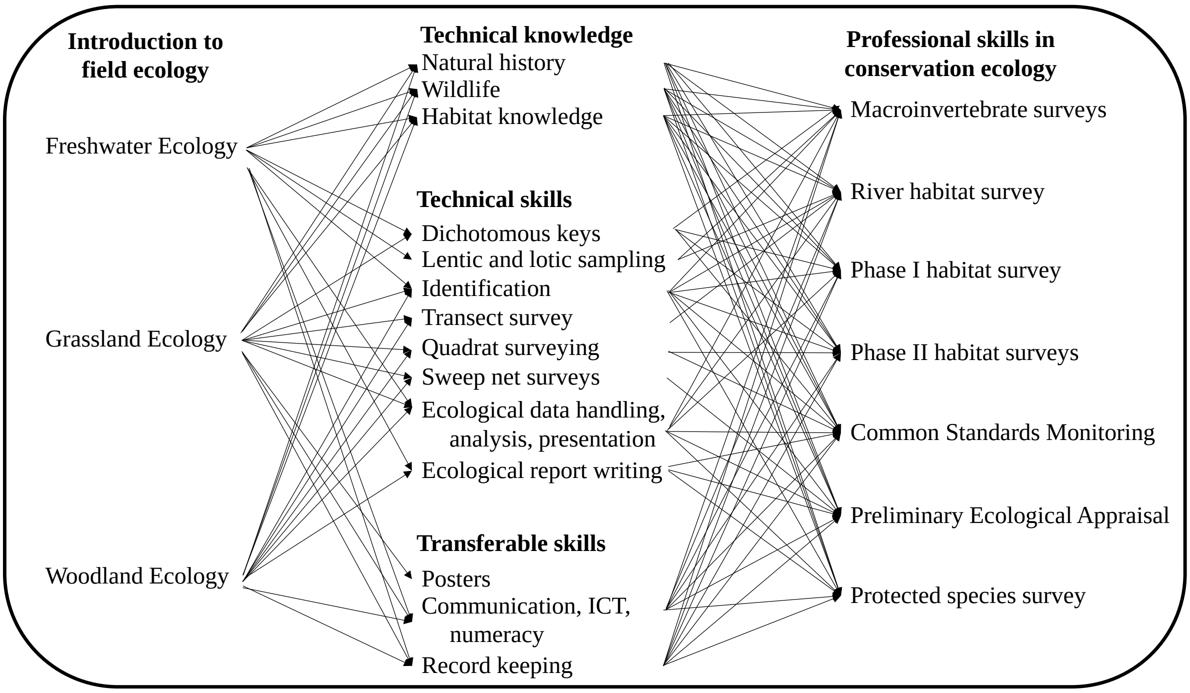

Figure 3. Student evaluation of the technical and transferable knowledge and skills developed during the ecological curriculum pathway.